



UNIVERSITI PUTRA MALAYSIA

**COLLABORATIVE VIRTUAL ENVIRONMENT SYSEM FOR
DISTANCE EDUCATION IN MATHEMATICS**

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**COLLABORATIVE VIRTUAL ENVIRONMENT SYSTEM FOR DISTANCE
EDUCATION IN MATHEMATICS**

By

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Distance Education today is available in most countries of the world. After appearance of Internet distance education became more available and convenient because Internet is known as the largest information network and nowadays Internet is present almost in every home. Forms of Distance education can be categorized as: asynchronous and synchronous. Synchronous distance education environment can be virtual class or other virtual environment (e.g. online chat, video conferencing) where educator and educated communicate in real time. Asynchronous – email, web forum.

Research presented in this thesis focuses in synchronous distance education in mathematics. The main question studied in this research is how to design learning environment for distance education in mathematics. To address this question such research areas as Computer Supported Collaborative Learning (CSCL) and some other related works are studied. CSCL is related how group of people separated by distance can learn in virtual environment collaboratively. Based on the best practices

of CSCL and related works in area of distance education in mathematics, we developed concepts and presented a way which can be used to design an environment for distance education in mathematics. Designed environment is used to develop software prototype.

Software prototype developed in this project named SynDiMath which stands for Synchronous Distance Mathematics. It allows synchronous collaboration through Internet of group of participants and teachers by giving them right to use shared resources such as workspace for writing Mathematical formulas, whiteboard for drawing and fast sketching of problem, chat and computational engine. Mathematica software developed by Wolfram Research (Mathematica 5.0, 2003) is used as computational engine. Developed software allows each client (student) to have two separate workspaces. First workspace called “groupspace” where group of students together with teacher may discuss Mathematical ideas and solve problems. Second is a personal workspace called “notepad” where student may work on personal assignments and have one to one discussion with teacher. Discussion can be saved as step-by-step history and reused in future with other group of students or single student as a lesson or tutorial. Alternatively content of discussion can be saved in HyperText Markup Language (HTML). In case of HTML content is static web page that can be included into website.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PELAKSANAAN PERSEKITARAN MAYA KOLABORATIF UNTUK PENDIDIKAN JARAK JAUH DALAM MATEMATIK

Oleh

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Pendidikan Jarak Jauh hari ini terdapat di kebanyakan Negara dalam dunia ini. Setelah kehadiran Internet pendidikan jarak jauh menjadi lebih mudah didapati dan selesa digunakan kerana Internet merupakan rangkaian terbesar maklumat dan pada masa kini Internet terdapat dalam hampir setiap rumah. Bentuk Pendidikan Jarak Jauh dapat dikategorikan sebagai: Tak serentak (asynchronous) dan serentak (synchronous). Persekitaran pendidikan jarak jauh serentak boleh berbentuk kelas maya atau persekitaran maya lain (seperti chat dalam talian, persidangan video) di mana pendidik dan pelajar berkomunikasi dalam masa nyata. Kaedah tak serentak adalah seperti dalam berbentuk email dan forum web.

Penyelidikan yang diterangkan dalam tesis ini memfokuskan kepada pendidikan jarak jauh serentak dalam matematik. Persoalan utama dikaji dalam penyelidikan ini ialah bagaimana mereka bentuk persekitaran pembelajaran bagi pendidikan jarak jauh dalam matematik. Bagi menjawab persoalan ini bidang penyelidikan seperti Pembelajaran Kolaboratif Berbantuan Komputer (PKBK) (Computer Supported Collaborative Learning (CSCL)) dan kajian-kajian yang berkaitan dikaji. PKBK atau

CSCL ialah mengenai bagaimana sekumpulan manusia yang berada berjauhan boleh belajar secara kolaboratif. Berdasarkan amalan terbaik PKBK atau CSCL dan kajian-kajian yang berkaitan, kita membangun konsep dan mempersembahkan cara yang dapat digunakan bagi mereka bentuk sebuah persekitaran untuk pendidikan jarak jauh dalam matematik. Persekitaran reka bentuk digunakan bagi membangun sebuah perisian prototaip.

Perisian prototaip yang dibangun dalam projek ini dinamakan SynDiMath singkatan untuk “Synchronous Distance Mathematics”. Ia membenarkan kolaborasi secara serentak (synchronous) melalui sekumpulan peserta dan guru dengan membenarkan mereka menggunakan sumber yang dikongsi bersama seperti ruang kerja (workspace) bagi menulis formula matematik, papan putih bagi melukis atau menggambarkan masalah, chat dan enjin komputasi. Perisian Mathematica yang dibangun oleh Wolfram Research (Mathematica 5.0, 2003) digunakan sebagai enjin komputasi. Perisian yang dibangun membenarkan pelajar mempunyai dua ruang kerja berasingan. Ruang kerja pertama yang dinamakan Ruang Kumpulan (groupspace) di mana sekumpulan pelajar dengan guru boleh berbincang idea matematik dan menyelesaikan masalah. Ruang kerja kedua yang dinamakan Pad Nota (notepad) di mana pelajar boleh bekerja secara bersendirian dengan membuat tugas peribadi dan boleh berbincang satu dengan satu dengan guru. Perbincangan boleh disimpan dan digunakan kemudian dengan kumpulan pelajar yang lain sebagai tutoran atau pembelajaran lain. Sebagai alternatif kandungan perbincangan boleh disimpan dalam HyperText Markup Language (HTML). Dalam kes HTML kandungan adalah statik dan boleh dipaparkan dalam laman web.

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LIST OF ABBREVIATIONS

Acronym	Description	Page
CSCL	Computer Supported Collaborative Learning	2
SynDiMath	Synchronous Distance Mathematics	3
ABC	Atanasoff-Berry-Computer	21
PDA	Personal Digital Assistant	21
PC	Personal Computer	21
WWW	World Wide Web	22
ICT	Information and Communications Technology	25
CAI	Computer Aided Instruction	38
DCD	Domain Centered Design	38
TCD	Teacher Centered Design	38
LCD	Learner Centered Design	40
CLP	Collaborative Learning Pattern	42
UP	Unified Process	42
MVC	Model-View-Controller	42
WYSIWIS	“What You See Is What I See”	43
WYMIWIM	“What You Model Is What I Model”	44
UML	Unified Modeling Language	52

TCP/IP	Transmission Control Protocol/Internet Protocol	52
API	Application Program Interface	57
GUI	Graphic User Interface	59
HTML	HyperText Markup Language	66
.NET	Microsoft Framework	70
JLink	Mathematica API Interface	70
XML	Extensible Markup Language	71
SQL	Structured Query Language	71
ADSL	Asymmetric Digital Subscriber Line	122
LAN	Local Area Network	122

CHAPTER 1

INTRODUCTION

1.1 Introduction

Over past few decades there has been a sudden trend toward new technology. The first computer was developed in 1937 (ABC computer), and by 1982 over 3.2 millions of computers were sold each year (Gary *et al.*, 2001). Electronic devices such as computers, hand phones, digital cameras, PDA's etc, which could hardly be found in one of thousand houses in 1970, nowadays can be seen in almost every office, house, school and university. As computers appeared on more and more of people's desks, the demand for certain previously unheard and unwanted products literally soared. Examples for such products are various software applications that allow PC holders to utilize their computers in the most effective ways.

In 1989 Tim Berners Lee invents an Internet-based hypermedia enterprise for information sharing, which later named as World Wide Web (WWW). With an infinite library of resources and data accessible on WWW via Internet, more that 125 million users are making use of Internet for a variety of reasons, some of which include following:

- sending messages (e-mail)
- accessing information, such as news, maps, airline schedule, stock market data, etc.
- online shopping

- online education
- meeting or conversing with people around the world
- accessing sources of entertainment and leisure, such as online games, magazines, etc.

Some of the above possibilities became widely available only with introduction of Internet and WWW. For example, previously the only way used to examine batch of students was to set specific date, time and place of examination; gather all students in auditorium (lecture hall, etc); issue examination paper and let the students work on the paper and submit it. Now, with emergence of online education, the entire process is so much flexible. For example student studying for TOEFL examination, can prepare and take examination at any date and time suitable for him. All that the student needs to do, is to come to any authorized examining centre (like British Council), take an online test and results can be known almost immediately.

Here is another example on use and importance of online education. Many universities now besides the normal and part-time courses, opening special courses that are based on distance learning. Such courses allow students enrolling from any part of the world. Online students will be given lectures to study, their instructor can be contacted through Internet in case any doubts or questions arise, and at the end of such course student will write an examination and receive a certificate. With introduction of online education, you may study a course that has not yet been conducted in your country/region and receive the original qualifications for it. From the examples we can see the uses and great benefits offered by online education.

Online education can be implemented through the Virtual Environment. The examples of virtual environments available are online tutorials, online courses, tutoring systems, digital video/voice conferencing and groupware. This thesis will concentrate on use of Groupware virtual environment in assisting online education. Groupware is the application software that allows a group of distance separated people to communicate and share virtual resources.

There are many difficulties faced by institutions that tried to use Groupware to run their online courses. The issue is that online courses that may need to use groupware vary from literature and language to mathematics and engineering. As you can imagine, the requirements to the Groupware used during a lecture on Mathematics highly different from those features necessary for teaching language. Any chat or messaging capabilities would be sufficient for teaching English online. But for Mathematics, features such as special displays of formulas, computations of equations, plotting of graphics, matrix manipulations, etc. will be necessary in order to teach and learn mathematics online.

1.2 Problem Statement

Since the invention of Internet many aspects of our life have been changed. Today we often hear terms like Virtual Office, Virtual Library, Virtual Showroom and others related to Virtual Environment. Distance education can be implemented through the concept of Virtual Environment. It is available in many forms. Most important to mention are: online courses, online tutorials, intelligent tutoring system, digital video/voice conferencing and groupware.

Collaborative Software or as it often called Groupware which allows group of distance separated people to solve problems collaboratively by sharing virtual workspace and tools. One of the examples of Groupware can be Collaborative Writing Software which allows editing of one document by group of distance separated people. Another example is White Board Groupware which allows group of people to share virtual white board.

Groupware, as well as video conferencing, provides real-time interaction between participants (usually it is done through text-chat or voice-chat, but also may be a video conferencing). The main idea of groupware is to make work more productive by sharing resources and tools amongst participants. Video of participants in case of Groupware comes at second place and usually used to support social part of group work. Different types of Groupware can be used to assist distance education. For example Collaborative Writing Software can be used in distance language education or White Board Groupware can be used to explain some of the geometry concepts.